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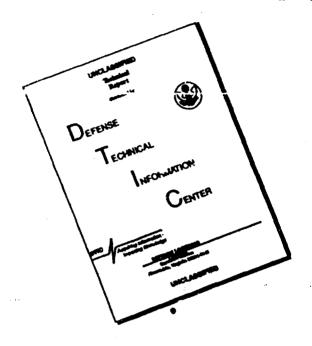
SCIENTIFIC AND TECHNICAL INFORMATION

CAMERON STATION, ALEXANDRIA, VIRGINIA



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GENERAL DYNAMICS | CONVAIR

Report No. 8926-094

Material - Finishes and Coatings - Wear Resistant

Abrasion Resistance

L. A. Mappus, J. C. George, E. E. Keller

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21 July 1959

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Abstract

Twenty materials consisting of various fabrics and tapes (polyester, teflon, nylon, dacron), fiberglass laminate (epoxy, polyester, phenolic), epoxy enamel hard anodized coatings (Anachronic Corp., Southgate, California), lubricant films, and Type 301 Half Hard stainless steel were applied to 2024-T3 and 7075-T6 aluminum alloy materials and wear tested in various combinations in a sliding abrasion test machine. Dacron tape (Connecticut Hard Rubber Co., New Haven, Connecticut, Temp = R- Tape) sandwiched bestween sliding 2024-T3 aluminum alloy surfaces displayed the best wear preventative characteristics of all the materials tested at 14 cycles of oscillation*under 2.5 psi pressure.

Reference: Mappus, L. A., George, J. C., Keller, E. E.,
"Abrasion Wear Preventive Devices In Vibrating
Faying Surfaces, Evaluation of," General Dynamics/
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REPORT 1P 50-470

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MODEL 30

TITLE

REPORT NO. 1.P 58-470

ABRASION WEAR PREVENTIVE DEVICES IN VIBRATING FAYING SURFACES -EVALUATION OF

MCDEL: 30

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CONVAIR

ANALYSIS
PREPARED BY Mappus
CHECKED BY George/Keller/Sutherland
REVISED BY

PAGE 1 REPORT NO. MP 58-470 MODEL 30 DATE 21 July 1959

INTRODUCTION:

In order to prevent the abrasive wear in faying surfaces of primary structures or parts whose replacement would be costly, the design groups intend to install wear preventive devices between the primary structure and bolted on doors, panels, fairings, etc. This test request was originated to evaluate various wear preventive devices installed in clad aluminum allow metallic joints and subjected to vibration.

OBJECT:

To evaluate, under simulated vibration conditions, various wear preventive devices installed in clad aluminum alloy faving surface joints.

CONCLUSIONS:

Of the 20 different wear preventive devices tested, Dacron Temp-R-Tape, manufactured by the Connecticut Hard Rubber Company, New Haven, Conn., was the best material tested for use in faying surface joints from the standpoint of wear prevention and ease of installation.

TEST SPECIMENS:

Twenty (20) different faying surface combinations were evaluated. In each combination, one surface was attached to, or a part of, an .040 inch thick sheet of 2024-T3 clad aluminum alloy. The other surface was attached to a 1.5 x 2 x 3 inch 2024-T3 aluminum alloy block. The faying surfaces are listed in Table I.

TEST PROCEDURE:

A photograph of the test jig is shown in Figure 1. The design of this machine made it possible to test sixteen (16) faying surface combinations simultaneously. A motor whose speed was controlled by a Variac, turned two cam wheels. Each cam actuated two rods, each rod moving & specimens. The rods were spring loaded to hold them against the cams. Loads were applied to each specimen by means of calibrated springs. Conditions set for this test were as follows: The motor speed was set at 850 RPM which was approximately fourteen (14) cycles per second; the cams were made to give an amplitude of vibration of .0625 inches; the springs were adjusted to give a pressure of 2.5 PSI on the faying surface joint.

Specimens without their own adhesive, were attached to the blocks and sheets by means of double faced Permacel Ne. 94 polyester tape. This method of attachment facilitated the removal and replacement of faying surfaces. When it was desired to eliminate a faying surface from test completely a metal sleeve was substituted for the block.

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GENERAL DYNAMICS | CONVAIR

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PAGE REPORT_NO.

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Material - Finishes and Coatings - Wear Resistant

Abrasion Resistance

Abstract

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REPORT NO. MP 58-470

ABRASION WEAR PREVENTIVE DEVICES IN VIBRATING FAYING SURFACES -EVALUATION OF

MCDEL: 30

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CONVAIR

ANALYSIS
PREPARED BY Mappus
CHECKED BY George/Keller/Sutherland
REVISED BY

PAGE 1 REPORT NO. MP 58=470 MODEL 30 DATE 21 July 1959

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PAGE 2 REPORT NO. MP 58-470 MODEL 30 DATE 21 July 1959

TEST PROCEDURE: (Cont d)

ANALYSIS

The faying surface joints were dis-assembled periodically for inspection. Photographs of the faying surfaces were taken after 20, 100, 200, and 300 hours of testing. These photographs are shown in Figures 2 thru 9. Each hour of testing represents 51,000 cycles. Tests were stopped after 300 hours (15,300,000 cycles).

RESULTS & DISCUSSION:

Results are listed in Table II. Conditions of the faying surfaces are shown in Figures 2. through 9. The Figure numbers and positions shown in Table II refer to the location of the most severe condition of wear for each faying surface combination in the Figures. Positions in the Figures are numbered from top to bottom and left to right as follows:

1 5 2 6 3 7 4 8

Faying surfaces 1, 4, 5, 6, 10, 11, 19, and 20 were all eliminated because of galling. Faying surfaces 8 and 9 were not considered because it is not practical to keep the joints lubricated. Faying surfaces 2, 3, 7, 12, 14, 15, 16, 17, and 18 did not offer as such protection as 13 and, in addition, would be more difficult to install in the production shop.

ACKNOWLEDGEMENT:

The test jig was designed by Mr. Gerard DeVries of the Convair, San Diego, Engineering Department.

NOTE: Test data from which this report was prepared may be found in Engineering Test Laboratories Data Book No. 3004.

Table I Faying Surfaces Tested

Sheet Surface	.040 inch 2024-T3 Clad al.alloy	.Ol'5 inch Nylatron GS	.002 inch Polyester tape 3M Co. Tape # 853	.040 inch 2024-T3 Clad al.alloy	.040 inch 2024-13 al.alloy	.040 inch 2024-19.6led al.alloy	.002 inch Polyester tape (Mylar) 3M Co. Tape # 853
Block Surface	.040 inch 2024-T3 Clad al.alloy	.015 inch Mylatron GS (Molybdenum disulphide impregnated nylon) Mfg. by Polymer Corp; Reading Pa.	.002 inch Polyester tape 3M Co. Impe # 853	.040 inch 2024-T3 Cled el.alloy Imbricated with ELF Lube Stick Mfg. by Aviation Lubricants Co; San Diego, Calif.	.040 inch 2024-T3 al.elloy with .002 inch hard anadized surface Mfg. by Anachrome Corp; Southgate, Calif.	.040 inch 7075 al. alloy with .002 inch hard anodized surface Mfg.by Anachrome Corp; Southgate, Calif.	.040 inch 2024-T3 al.alloy with .002 inch hard anodized surface Mfg. by Anachrome Comp; Southgate, Calif.
Faying Surface No.	el	cv.	٣	₹	ñ.	9	L

Table I(Cost'd)

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Sheet Surface	.040 inch 2024-T3 Clad al.alloy	Convair Spec.0-03021, Type II White epoxy enamel Mfg.by Andrew Brown Co.	.040 inch 2024-13 al.alloy with .002 inch hard anodized surface, Mfg. by Anachrome Corp. Southgate, Calif	.040 inch 2024-13 alication with .002 inch hard anodized surface, Mig. by Anachrome Corp. Southgate, Calif.	.040 inch 2024-T3 Clad al.alloy	.040 inch 2024-T3 Clad al.alloy
Block Surface	Convair Spec. 0-03021, Type II White epoxy enamel, Mfg.by Andrew Brown Co. Lubricated with ELF Labestick	Convair Spec. 0-03021, Type II White epoxy enamel, Mfg.by Andrew Brown Co. Lubricated with ELF Lubestick	.040 inch 2024-13 al.alloy with .002 inch hard ancdized surface, Mfg. by Anachrome Corp. Southgate, Calif.	.01\$ inch 301 1/2 hard stainless steel	.015 inch Mylatron film Mfg. by Polymer Corp; Reading Pa.	Dacron tape, TempR-Tape DV (CVAC No.310282) Mfg. by Connecticut Hard Rubber Co; New Haven, Conn.
Eaying Surface No.	æ	ø	0	a.	12	13

Table I(Cont'd)

Sheet Surface	.040 inch 2024-13 Clad al.alloy	.040 inch 2024-T3 Clad al.allacy	.040 inch 2024-T3 Glad al.alloy	.040 inch 2024-T3 Clad al.alloy	.040 inch 2024-T3 Cled al.alloy	.040 insh 2024-T3 Cled al.allby	Convair Spec. 0-03021, Type II epoxy enamel (white) mig. by Andrew Brown Co.
Block Surface	.0065 inch Teflon Tape 3M Co. No.549	.002 inch Polyester Tape 3M Co. No.853	.031 inch Epoxy Leminate Mil-P-18177A, Type GEE	.031 inch Folyester Leminate Mil-P-8013, Type I	.031 inch Phenolic Leminate Mil-P-15035B, FRM	.012 inch Type 301,1/2 hard stainless steel,Mil-3-5059A	Convair Spec.0-03021, Type II white epoxy enamel, mfg. by Andrew Brown Co.
Faying Surface No.	7	. B	9 .	2 4	80	16	. 20

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Table II Results of Tests

Relative Rating	Poor	Good	Good	Poor	Poor	Poor	ල්ල ල්ල	poog	Good	Poor
Ref. Fig. No.& Position	Fig.8 Pos.1	ं	F18.8 Pos.3	F18.4 Pos.4	Not. shown.	₩ ₩ ₩ ₩ ₩	F.8.8.7	7 7 8 8 8 8 8 8	F18.8 Pos.4	Not shown
Comments	Control-discontinued after 210 hours because of severe galling	Good abrasion resistance but not as easily installed ERIE.S. Res.2.	Same as above	Galling occured even with jubrication	Discontinued because of galling, substituted faying surface No.10	Discontinued because of galling	No advantage over faying surface No.15	Protected aluminum but may not be practical to keep surface lubricated	Same as above	Discontinued because of galling
Hours Tested	210	300	0 0.	001	10	%	300	300	200	Ħ
Feying Surface No.	e	N	· m	4	×۸	ŵ	Ŀ	∞	6	10

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Faying Surface No.	Hours Tested	Comments	Ref.Fig. No.& Position	Relative Reading
Ħ	30	Macentigued because of galiing & fretting corrosion	1.8°.4. 1.8°.4. 1.8°.4.	Poor
12	300	Cled aluminum scratched by Nylatron	Fig.9 Pos.1	g o og
ឧ	300	Clad aluminum in excellent condition; Dacron fabric is only slighty worn.	71g.9 Pos.2	Excellent
77	900	Cled eluminum slighty scratched	Fig.9	Good
213	300	Glad aluminum slighty scratched	P18.9 Pos.4	(Bood)
3 6	300 Y	In all three of these cases, the wear occured on the fiberglass laminate. Clad aluminum not worn.	F86.9	B oog
17	300		F18.9	(Pood)
18	300		F1g. 9 Pos.7	POOG P
61	100	Discontinued after 100 hours because of wear and galling	F1g.5 Pos.8	Poor
8	200	Galling	64 G. 20 € 20 € 20 €	Poor

Table II (Cont'd)

ANALYSIS

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FIGURE 1

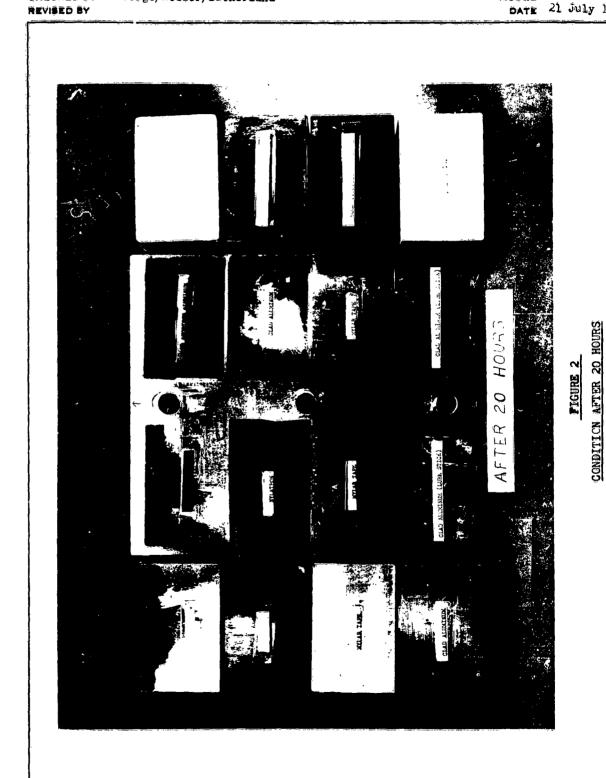
FAYING SURFACE ABRASION TEST JIG

ANALYSIS

CONVAIR

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CHECKED BY George/Keller/Sutherland

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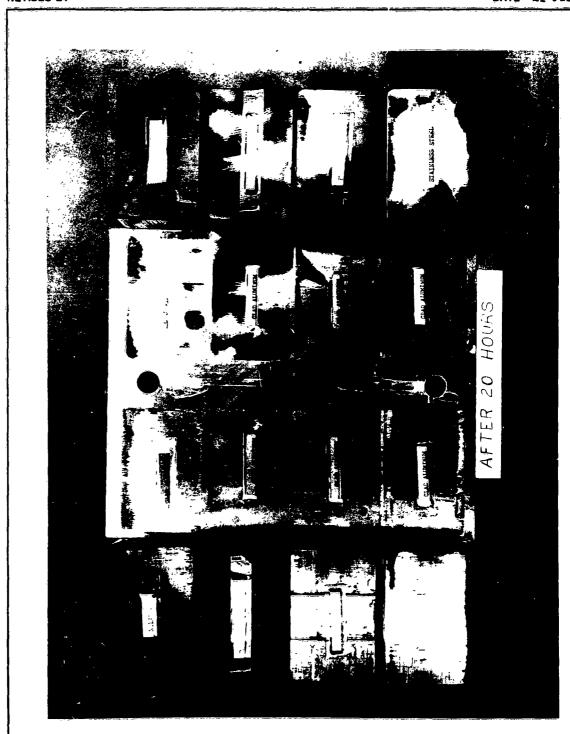


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CONVAIR SAN DIGO

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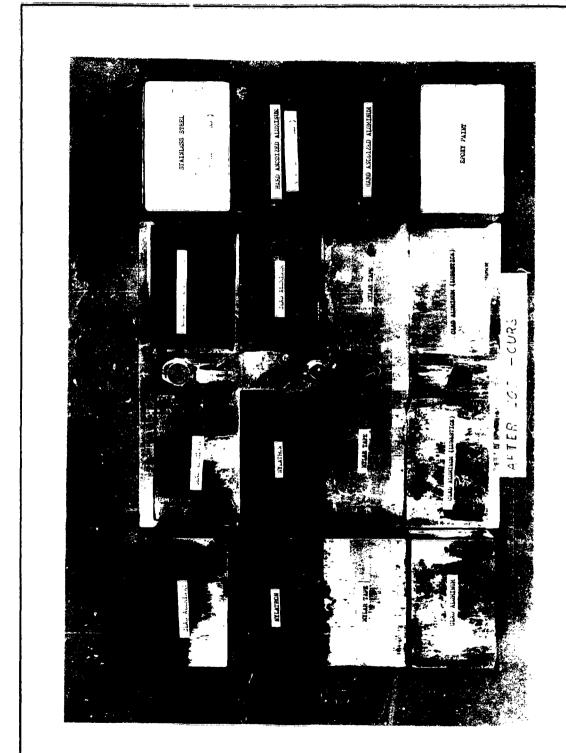
CONDITION AFTER 20 HOURS

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CONDITION AFTER 100 HOURS

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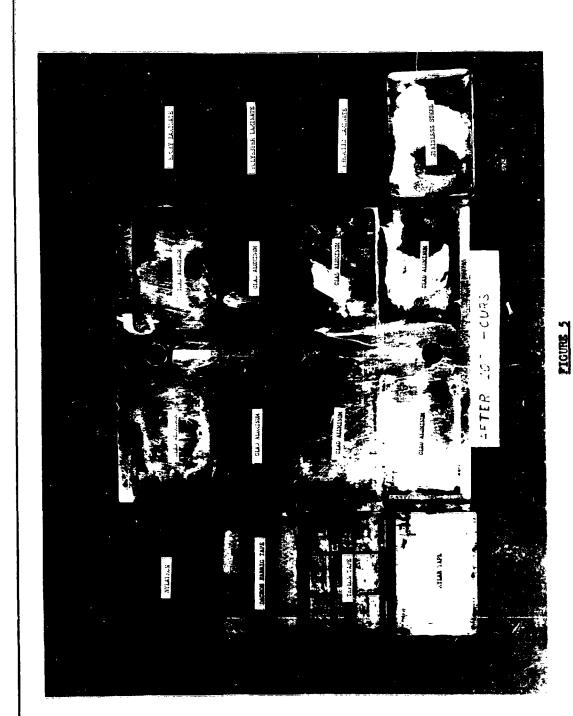
ANALYSIS

CONVAIR SAN DIEGO

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MODEL 30
DATE 21 July 1959



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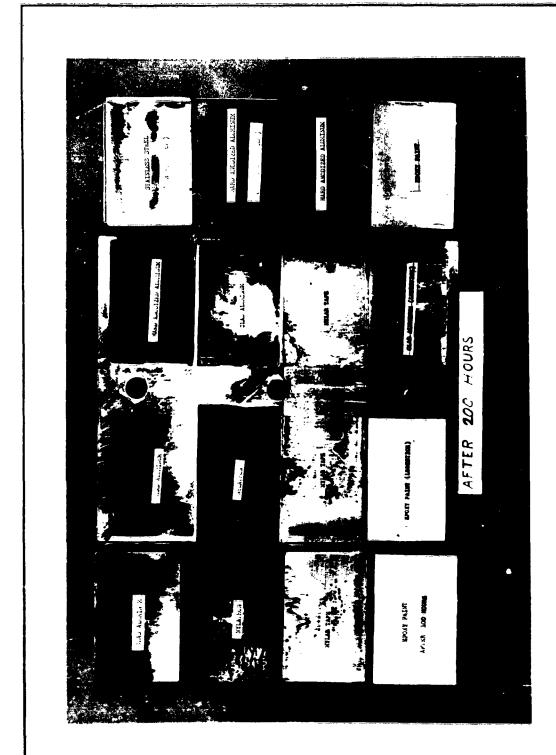
CONDITIONS AFTER 100 HOURS

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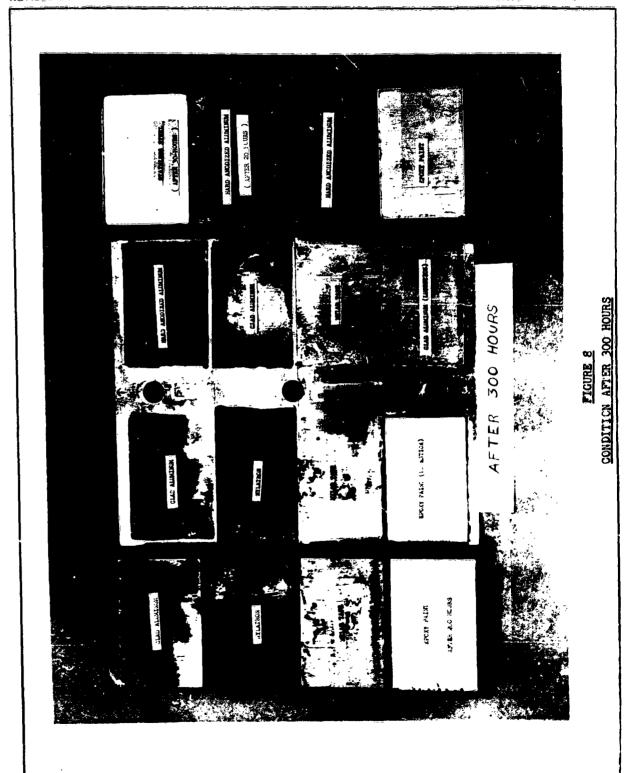


CONDITION AFTER 200 HOURS

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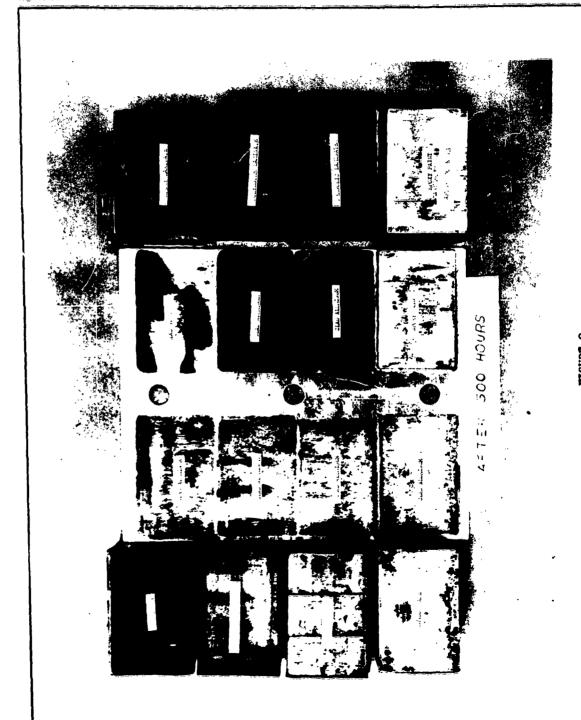
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CONVAIR SAN DIEGO Mappus George/Keller/Sutherland

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CONDITION AFTER 300 HOURS FIGURE 9